User Guide

196-02-C - DA7322 Audio Codec with DSP

UG-196-02-C

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1 Terms and definitions

AIF	Digital Audio Interface
CLK	Clock
DIO	Digital Input/Output
DMIC	Digital Microphone
DUT	Device Under Test
DSP	Digital Signal Processor
ECM	Electret Condenser Microphone
EVB	Evaluation Board
GPIO	General Purpose Input Output
GUI	Graphical User Interface
I2C/SPI	Inter-Integrated Circuit/Serial Peripheral Interface
I2S	Integrated Interchip Sound
MCLK	Master Clock
OS	Operating System
PCB	Printed Circuit Board
PDM	Pulse Density Modulation
PSU	Power Supply Unit
SPDIF	Sony Philips Digital Interface Format
USB	Universal Serial Bus

2 References

1. UG-179-07-D, 179-07-D Digital IO board User Guide, Dialog Semiconductor

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3 Introduction

The DA7322 Evaluation Board (EVB) has been designed to allow measurement and evaluation of the DA7322 device. The EVB is supplied with a USB memory stick containing various documents and software to allow you to control the DA7322.

The software is called Power Commander and uses a simple graphical user interface to allow you to control the DA7322 via the USB port of a PC.

The EVB has a number of jumper links providing the flexibility to change the system configuration and to allow the required measurements to be made.

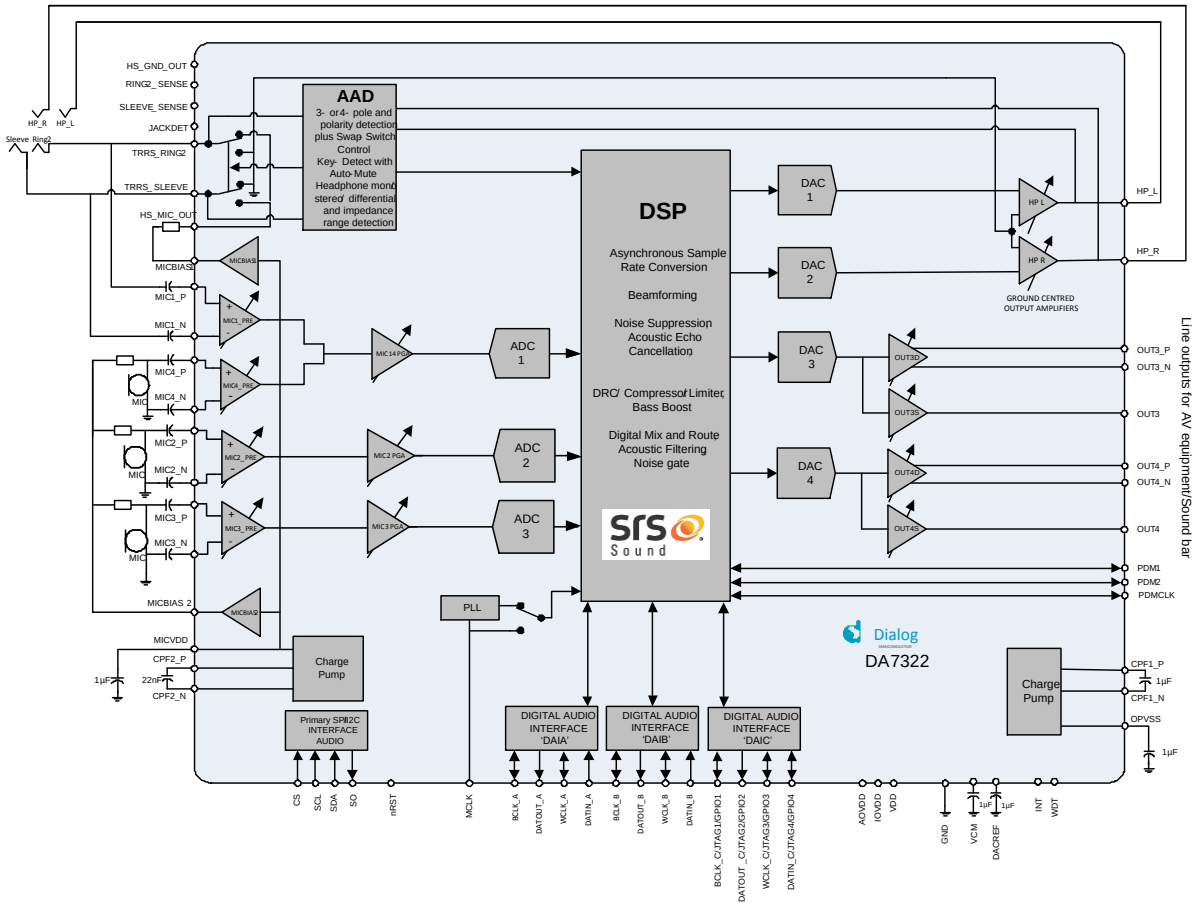

Figure 1: DA7322 Block diagram

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4 Summary

This document provides information about the EVB and Power commander software to allow testing and evaluation of the DA7322 Audio Codec with DSP.

The hardware solution is based upon two PCBs:

- Digital IO Board - 179-07-D (*see* References *section)*
- DA7322 Evaluation board - 196-02-C

Power Commander requires a PC operating Windows 2000/XP/Vista/Windows 7 with a USB interface.

To run Power Commander under Windows Vista, set the default installation location to 'C:\Dialog Semiconductor\'.

Power Commander allows you to:

- Configure the DA7322 using one of the several pre-loaded initialisation files (i.e. start-up sequences)
- Read and write to all control registers
- Monitor the device status

Note 1 Dialog recommends connecting the EVB+digital IO board to a 500 mA capable USB port as we cannot guarantee that a USB hub (set to 100 mA) is sufficient to operate it correctly. When using the on board class D amplifiers, an external supply must be used to provide sufficient power to operate the high power speaker drivers on the EVB.

5 Hardware

The DA7322 EVB platform consists of two boards that connect together. The first board is the EVB containing the DA7322 device and essential external components. This board can also be used as a standalone board or as a module for a customer development platform provided the essential supplies and inputs are correctly connected to the board.

The second board is the Digital IO board which provides the required power and USB control interface to the DA7322 EVB to allow signals to be easily connected and configured into the DA7322 device. The digital IO board is referenced in a separate document (UG-179-07-D) which explains the various connections available and the jumper configurations for the board.

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5.1 DA7322 EVB

The DA7322 EVB (196-02-C) contains the DA7322 and associated components, configuration pins/jumpers, input/output connectors and measurement points for flexible configuration and access to the DA7322. It includes:

- 4 x 3.5mm analogue microphone sockets
- 2 x 3.5mm differential lineout sockets
- 1 x 3.5mm single ended lineout socket
- 1 x 3.5mm Headphone jack (supporting 3 and 4 pole jacks)

The board and default jumper setting are shown in Figure 2 and a description of the individual jumpers are shown in Table 1.

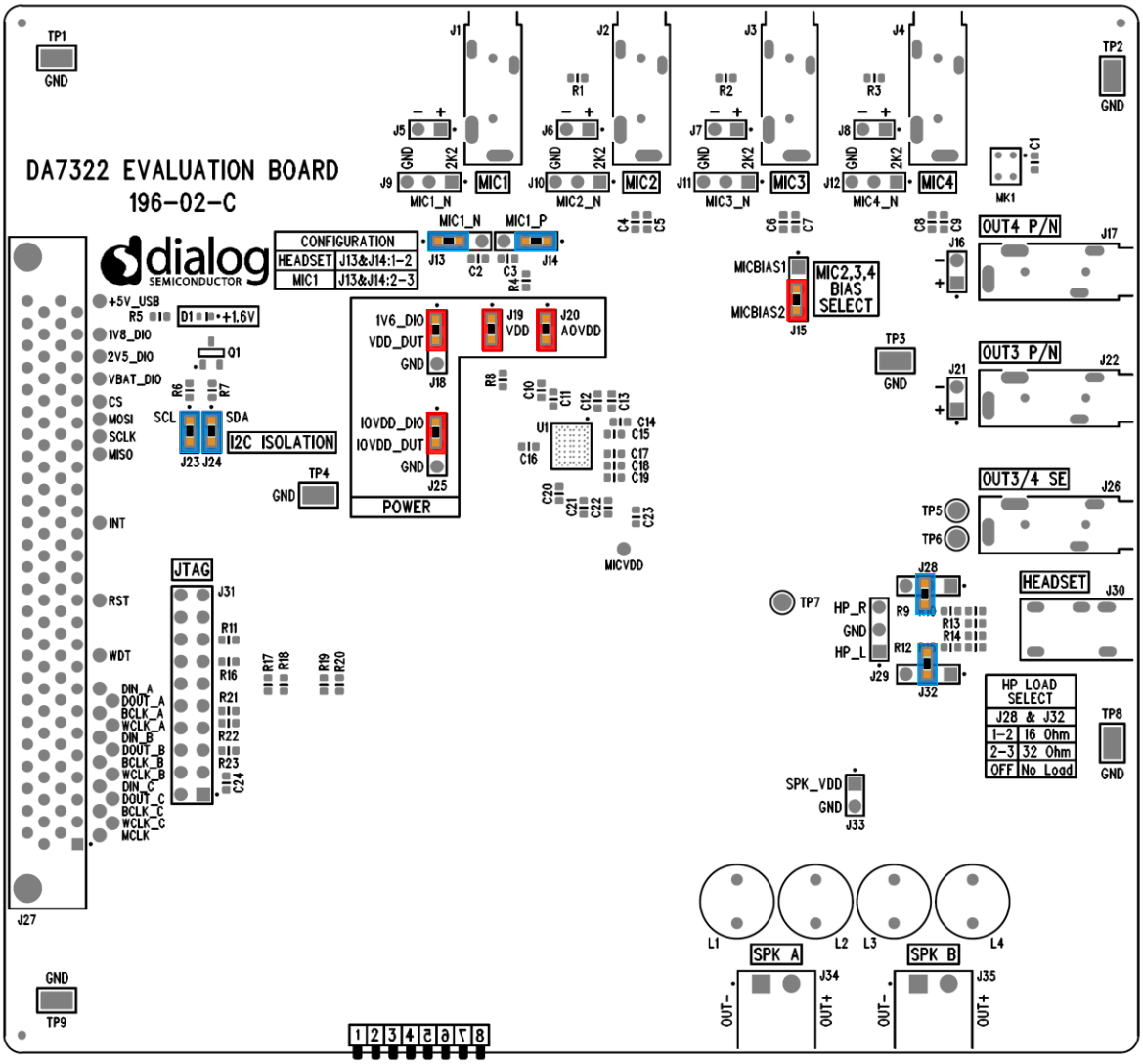

Figure 2: EVB default jumper settings

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5.2 Jumper and connector information

Table 1: 196-02-C Jumpers link positions and connectors

Reference Designator	Position/pins	Function
J1		3.5mm connector for MIC 1 input
J2		3.5mm connector for MIC 2 input
J3		3.5mm connector for MIC 3 input
J4		3.5mm connector for MIC 4 input
J5	Pin 1: + Pin 2: -	Differential P/N MIC1 input
J6	Pin 1: + Pin 2: -	Differential P/N MIC2 input
J7	Pin 1: + Pin 2: -	Differential P/N MIC3 input
J8	Pin 1: + Pin 2: -	Differential P/N MIC4 input
J9	Short 1-2	MIC1 -VE input pulled to GND with 2.2kΩ for two wire ECM configuration
	Short 2-3	MIC1 -VE input shorted to GND for single ended microphone input configuration
	No Jumper (default)	MIC1 -VE input pulled to GND with 47kΩ for differential ECM microphone input configuration
J10	Short 1-2	MIC2 -VE input pulled to GND with 2.2kΩ for two wire ECM configuration
	Short 2-3	MIC2 -VE input shorted to GND for single ended microphone input configuration
	No Jumper (default)	MIC2 -VE input pulled to GND with 47kΩ for differential ECM microphone input configuration
J11	Short 1-2	MIC3 -VE input pulled to GND with 2.2kΩ for two wire ECM configuration
	Short 2-3	MIC3 -VE input shorted to GND for single ended microphone input configuration
	No Jumper (default)	MIC3 -VE input pulled to GND with 47kΩ for differential ECM microphone input configuration
J12	Short 1-2	MIC4 -VE input pulled to GND with 2.2kΩ for two wire ECM configuration
	Short 2-3	MIC4 -VE input shorted to GND for single ended microphone input configuration
	No Jumper (default)	MIC4 -VE input pulled to GND with 47kΩ for differential ECM microphone input configuration
J13	Short 1-2 (default)	Connects MIC1_N to J30 (Headset) internally via chipset
	Short 2-3	Connects MIC1_N to J1 (MIC1) connector
J14	Short 1-2 (default)	Connects MIC1_P to J30 (Headset) internally via chipset
	Short 2-3	Connects MIC1_P signal to J1 (MIC1) connector

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J15	Short 1-2	Selects MICBIAS1 output to supply MIC 2/3/4 bias voltages
	Short 2-3 (default)	Selects MICBIAS2 output to supply MIC 2/3/4 bias voltages
J16	Pin 1: + Pin 2: -	Differential OUT4 P/N output
J17	Sleeve: GND Ring: OUT4_N Tip: OUT4_P	3.5mm socket for differential OUT4
J18	Short 1-2 (default)	Connects 1V6_DIO supply (from digital IO) to VDD_DUT supply input (EVB), This link can be replaced with an ammeter for current monitoring
	Pin:3	GND connection for connecting external supply between Pin 2 (1V6 supply to part) and Pin 3 GND
J19	Short 1-2 (default)	Jumper to break out 1V6 supply connection and VDD for current monitoring or external supply
J20	Short 1-2 (default)	Jumper to break out AOVDD supply connection for current monitoring or external supply
J21	Pin 1: + Pin 2: -	Differential OUT3 P/N output
J22	Sleeve: GND Ring: OUT3_N Tip: OUT3_P	3.5mm socket for differential OUT3
J23		SCL isolation jumper – see Table 2
J24		SDA isolation jumper - see Table 2
J25	Short 1-2 (default)	Connects IOVDD_DIO supply (from digital IO) to IOVDD_DUT supply input (EVB), This link can be replaced with an ammeter for current monitoring
	Pin:3	GND connection for connecting external supply between Pin 2 (IOVDD supply to part) and Pin 3 GND
J26	Sleeve: GND Ring:OUT4_SE Tip: OUT3_SE	3.5mm socket for OUT3/4 single ended output
J27		100 pin connector to digital IO board
J28	Short 1-2	Inserts a 16Ω load across the right headphone output for test purposes
	Short 2-3	Inserts a 32Ω load across the right headphone output for test purposes
J29		For internal use only
J30		3.5mm headphone socket supporting 3 and 4 pole jacks
J31		For internal use only
J32	Short 1-2	Inserts a 16Ω load across the left headphone output for test purposes

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	Short 2-3	Inserts a 32Ω load across the left headphone output for test purposes
J33	Pin:1	External supply connection point for SPK_VDD supply, used by class D amplifiers.
	Pin:2	GND connection for connecting external supply between Pin 1 (SPK_VDD supply to class D amplifiers) and Pin 2 GND
J34		Speaker A output connector from class D speaker output
J35		Speaker B output connector from class D speaker output

5.3 Power supplies

The DA7322 EVB is connected to the digital IO board via the large 100 pin connector (J27) which allows the boards to mate together, The boards are powered when a USB cable is connected to J1 (+5V_USB) on the digital IO board.

Using the default jumper settings (J18, J19, J20 and J25 on EVB) shown in Figure 3, the DA7322 device on the EVB is powered from the supplies on the digital IO board. The two supplies used from the digital IO board are 1V6_DIO (supply for VDD) and IOVDD_DIO (supply for IOVDD & AOVDD). The IO supply is user selectable on the digital IO board depending on what IO voltage is required.

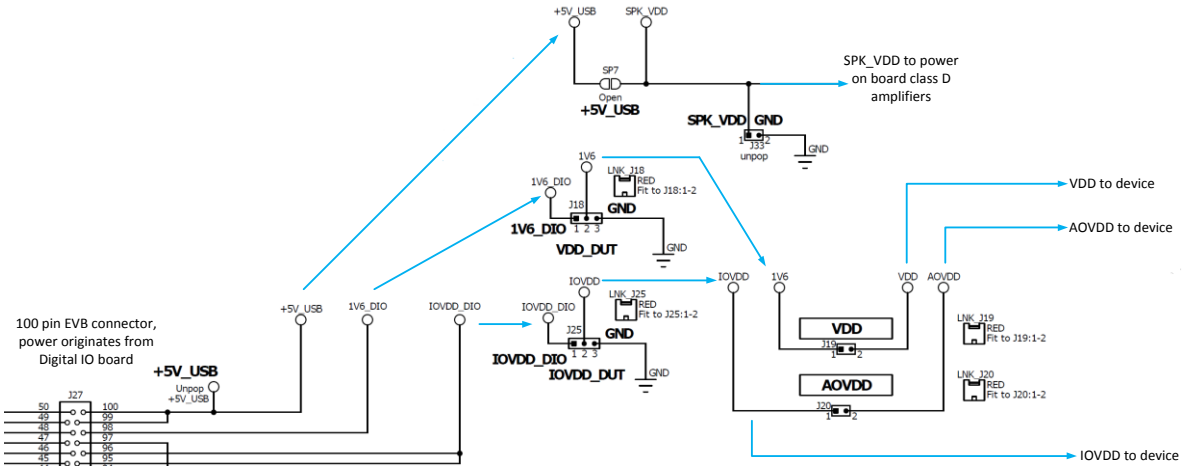

Figure 3: DA7322 supplies and connections on EVB

The DA7322 EVB allows external supplies to power the board by removing J18 and J25 jumpers. Supplying power to Pin 2 and ground on Pin 3 of J18 and J25 allows the board to be powered independently of the digital IO board. Current measurements on individual supplies can also be performed by connecting an ammeter between the supply and Pin 2 of the jumper when using an external supply. Current can also be measured by connecting an ammeter across pins 1 and 2 if using the on board digital IO board regulators to power the board.

All power to the on-board digital IO regulators are supplied from +5V on the USB connector (normally limited to 500mA maximum). The supply for the on-board class D amplifiers of the EVB can be supplied from this +5V USB supply through SP7 but this is not recommended. The jumper J33 gives the ability to power the on-board class D amplifiers from an external +5V power source as these can draw high current when driven at full power. It is recommended that an external supply is used in this way whenever the class D amplifiers are used.

Note 2 When using ammeters to measure the current to the device, ensure that any voltage drop across the ammeter is accounted for so that the supply voltage reaching the device is at a sufficient level. Adding

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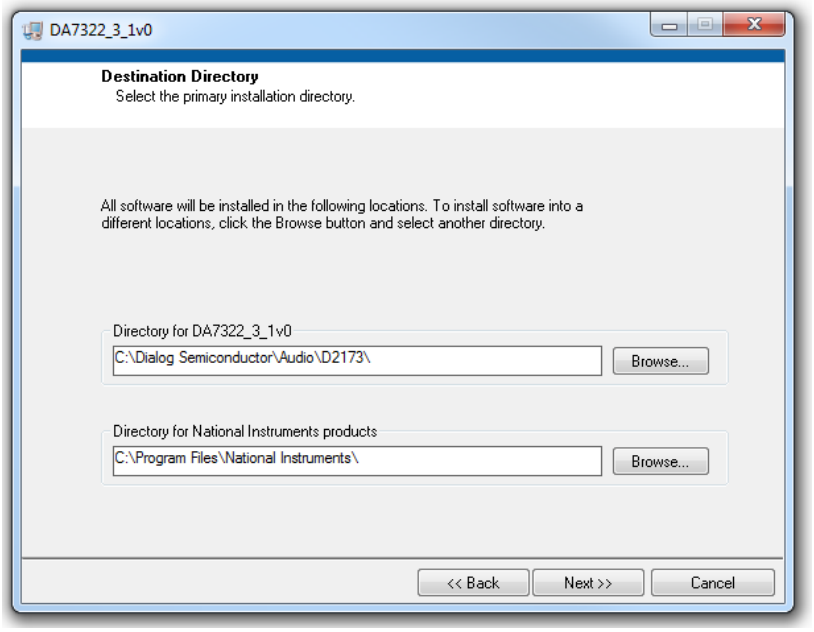
extra impedance in the supply lines such as ammeters can also reduce the performance of the device under test.

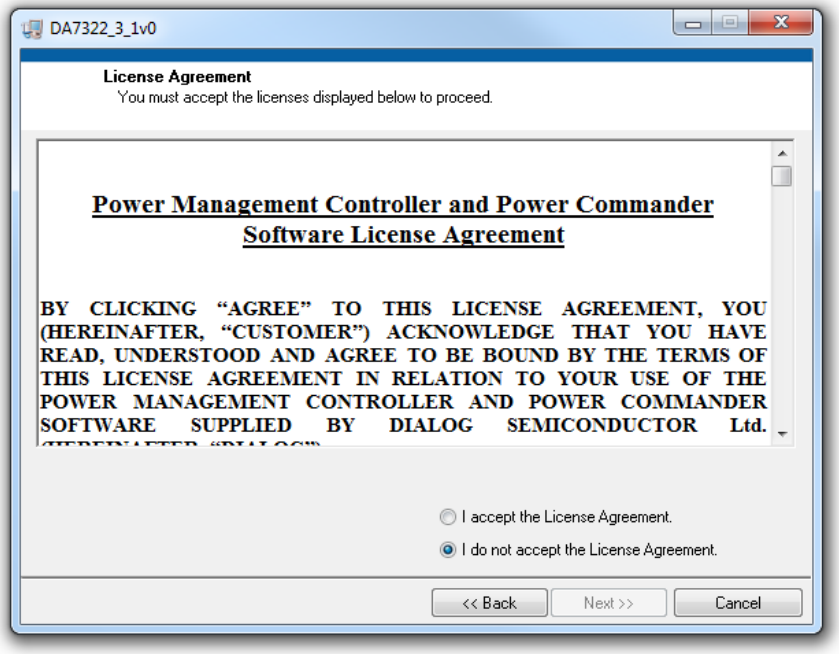
6 Power commander software

6.1 Installation

Using the USB memory stick provided with the EVB kit, run the ‘setup.exe’ file (USB\Power commander\setup.exe).


DA7322_3_1v0
Destination Directory
Select the primary installation directory.
All software will be installed in the following locations. To install software into a different locations, click the Browse button and select another directory.
Directory for DA7322_3_1v0
C:\Dialog Semiconductor\Audio\D2173\
Browse...
Directory for National Instruments products
C:\Program Files\National Instruments\
Browse...
<< Back
Next >>
Cancel

Click ‘Next>>’


DA7322_3_1v0
License Agreement
You must accept the licenses displayed below to proceed.
Power Management Controller and Power Commander Software License Agreement
BY CLICKING “AGREE” TO THIS LICENSE AGREEMENT, YOU (HEREINAFTER, “CUSTOMER”) ACKNOWLEDGE THAT YOU HAVE READ, UNDERSTOOD AND AGREE TO BE BOUND BY THE TERMS OF THIS LICENSE AGREEMENT IN RELATION TO YOUR USE OF THE POWER MANAGEMENT CONTROLLER AND POWER COMMANDER SOFTWARE SUPPLIED BY DIALOG SEMICONDUCTOR Ltd.
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Cancel

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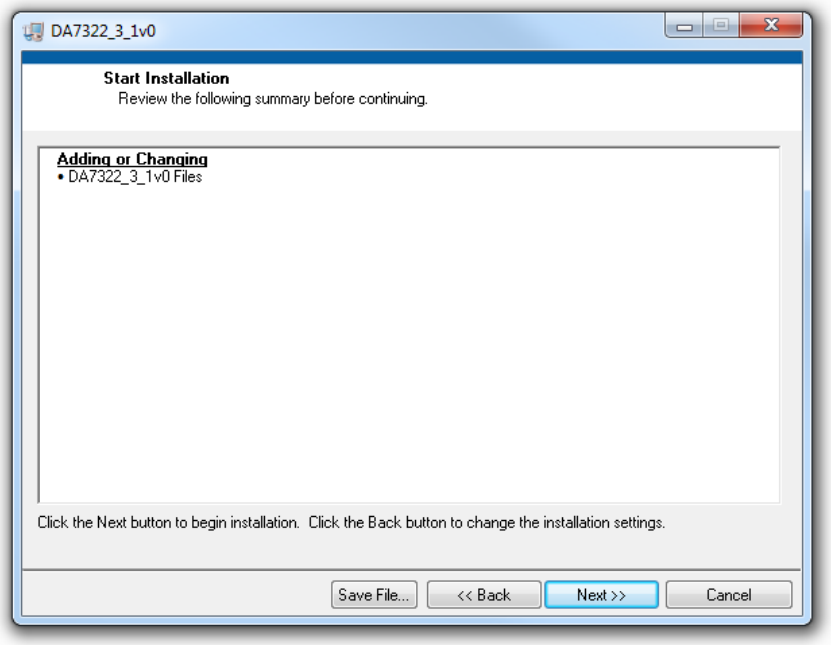
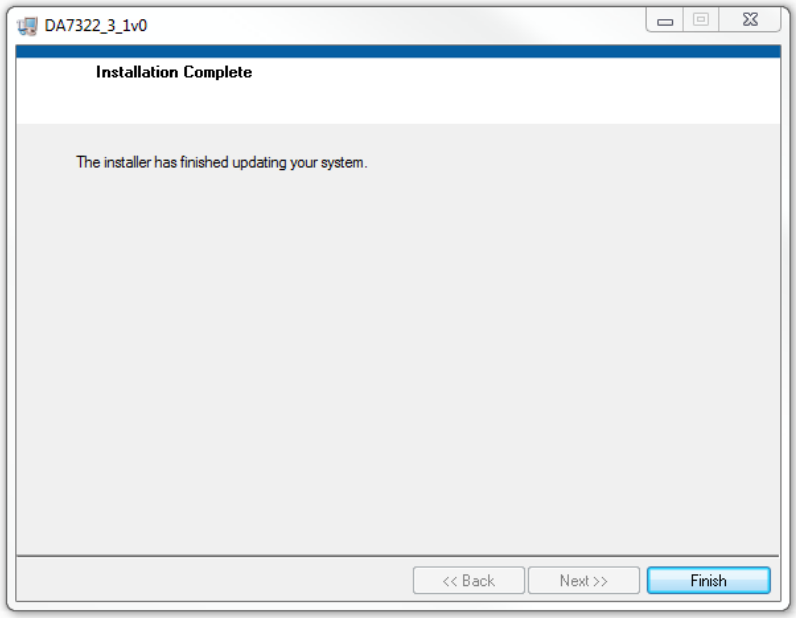
Select ‘ I accept the licence Agreement.’ then Click ‘Next>>’



Click ‘Next>>’ and wait for files to install



Click ‘Finish’

You may need to restart your computer. In this case a pop up window will appear asking you to do so.

Once the software is installed, plug the USB cable into the Digital IO board which must also be connected to the EVB through the large 100 pin connector of each board. Windows should detect the

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USB device and automatically install the driver. If not, the driver is included on the USB stick supplied with the EVB kit.

6.2 Power commander interface

Run the DA7322/3 Power commander software by clicking the shortcut on the appropriate item in the Start menu (All Programs>Dialog Semiconductor>Audio>). The screen shown in Figure 4 will appear.

The best setting for the PC display size is 1024x768 pixels or above. Font size on the PC display should be Normal (95dpi). It is important to note that a display size other than the recommended setting will affect the way in which the panels appear.

To start the device, plug in the USB cable to the digital IO board.

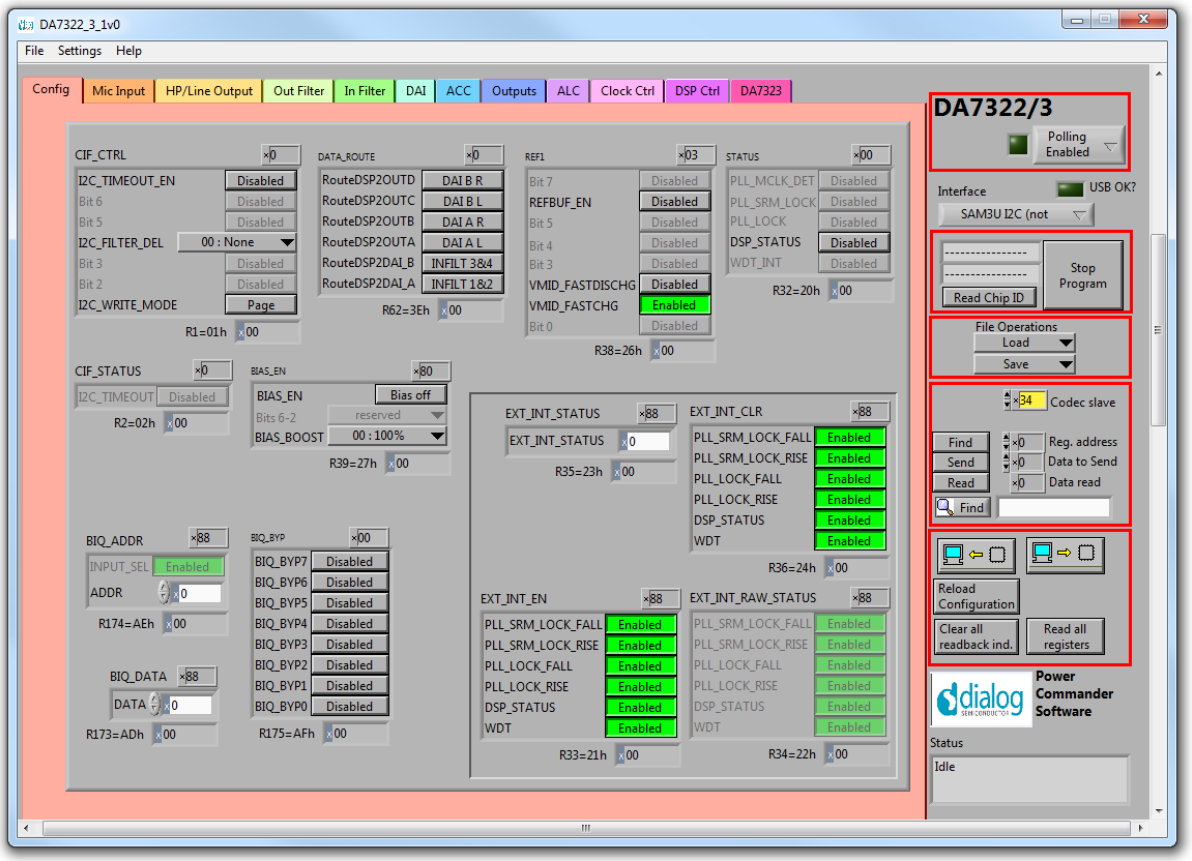

Figure 4: Initial interface

The [USB OK?] LED should illuminate steady green if the USB interface is correctly connected and operational. If the [USB OK?] LED is blinking and yellow, it indicates that the device is not yet communicating via the I2C interface. See the Troubleshooting section of this document for more details.

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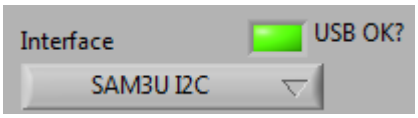
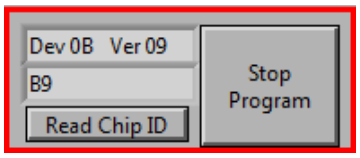
6.3 Status and controls

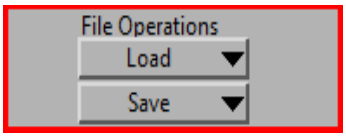
- **Polling Enabled** By default the current page of device register content is updated via polling the I2C interface. If disabled, these read-backs are suppressed. This is used to force the communication over the bus to be silent. If this is set to automatic, the program will only poll the device while the application is the topmost window. If obscured by another program or window, polling will be disabled.
- **LED** If the device is active this LED is green. If the LED is red the device is inactive



- **Interface** Selects between SAM3U I2C/SPI control and offline mode. Switching to offline, then back to SAM3U I2C/SPI reinitialises the USB interface. I2C mode is the default communication setup for the device
- **USB OK?** Solid green illumination indicates that the USB is OK and communicating.



- **Stop Program** This terminates the program. If there are unsaved changes, a dialog box is displayed.
- **Read Chip ID** This reads the Chip ID from the device and displays the content in the text box above the button. The text box indicates the device version when the device is active. When inactive, version status will not be correct.



- **Load** Loads previously saved text files, sends loaded register values in file and reads back all registers from device. Selecting ‘Load’ opens a list of other options related to loading files. Select ‘load codec file ..’ to bring up a dialog box which allows you to select, view, copy or re-name files. Once a file has been selected, ‘Load codec file..’ opens the file and executes commands listed in the file to manipulate the registers of the device allowing the device to be quickly configured for different setups with a script file. Load codec file should always be used when using audio based devices, Load is used for non-audio based device configuration.
- **Save** Saves the current panel state to a text file. Selecting ‘Save Codec file..’ saves the codec registers in a text file with sequential register address number, value of register and name listed in the file. Selecting ‘Register Dump’ option saves the current register values to a text file in a slightly different format, the register name and value of register are shown in the file content. See Appendix A for further details. Save Codec should be used when using audio based devices.

Note 3 The difference between ‘Save’ and ‘Register Dump’ is that the ‘Save’ option dumps the contents of all panel controls to the file (a save state operation); whereas, ‘Register Dump’ reads the device contents (including status registers) into the file. Also some codec registers do not have read-back capability.

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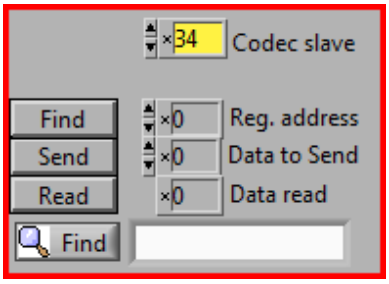
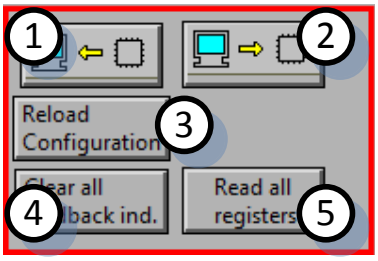


- **Slave Address** Sets the slave address of the device. This affects all I2C/SPI communication. The codec slave address for DA7322 is 0x34 and this is the 8bit value (34h for Write, 35h for Read).
- **Find** Finds the register address location entered into the 'Reg. address' field control of the GUI and highlights the location of the register if found.
- **Send** Sends a single byte of data to the device using the Slave Address, Reg. Address and Data to Send.
- **Read** Reads a single byte of data from the device using the Slave and Reg. Address.
- **Find** Finds a control matching a full or partial register name, a control bit name, or a register number (e.g. R23 or 17h). Pressing 'Find' repetitively will step through all matching items.

Note 4 If the Device Address does not match the port numbers on the device, this can be used to control/read any other device on the I2C/SPI bus.



1. **Synchronise Panel from Device** Reads all the register contents of the device and updates the panel to match.
2. **Synchronise Device from Panel** Writes all the device registers to match the panel. (Refresh operation)
3. **Reload Configuration** Resets registers to values specified in configuration file for the PMIC section and default values for the codec.
4. **Clear all I2C read-back indicators** Sets all read-back indicators to 0.
5. **Read All Registers** Reads all registers, comparing with the panel controls.

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6.4 Register control Interface

The control interface has a series of coloured tabs along the top of the interface. These are used to select a group of registers for different areas of the device. The tabs available along the top of the interface are Config, Mic Input, HP/Line Output, Out Filter, In Filter, DAI, ACC, Outputs, ALC, Clock Ctrl, DSP Ctrl and DA7323 as shown in Figure 5.

Each tab can be selected by left clicking on the tab. A register cluster is then displayed below for the associated tab. These consist of a mixture of Boolean toggle buttons, multi-value ring controls, or slide controls, as well as a hexadecimal read-back indicators showing the total equivalent register value and a read-back indicator showing the current register value. The Event Register is labeled with a register number in decimal and its hexadecimal equivalent.

The read-back indicator readings can be switched individually to decimal, octal, hexadecimal or binary by clicking on the 'x', or they may all be changed at once between hexadecimal and binary using the 'Settings>Binary Indicators' menu item.

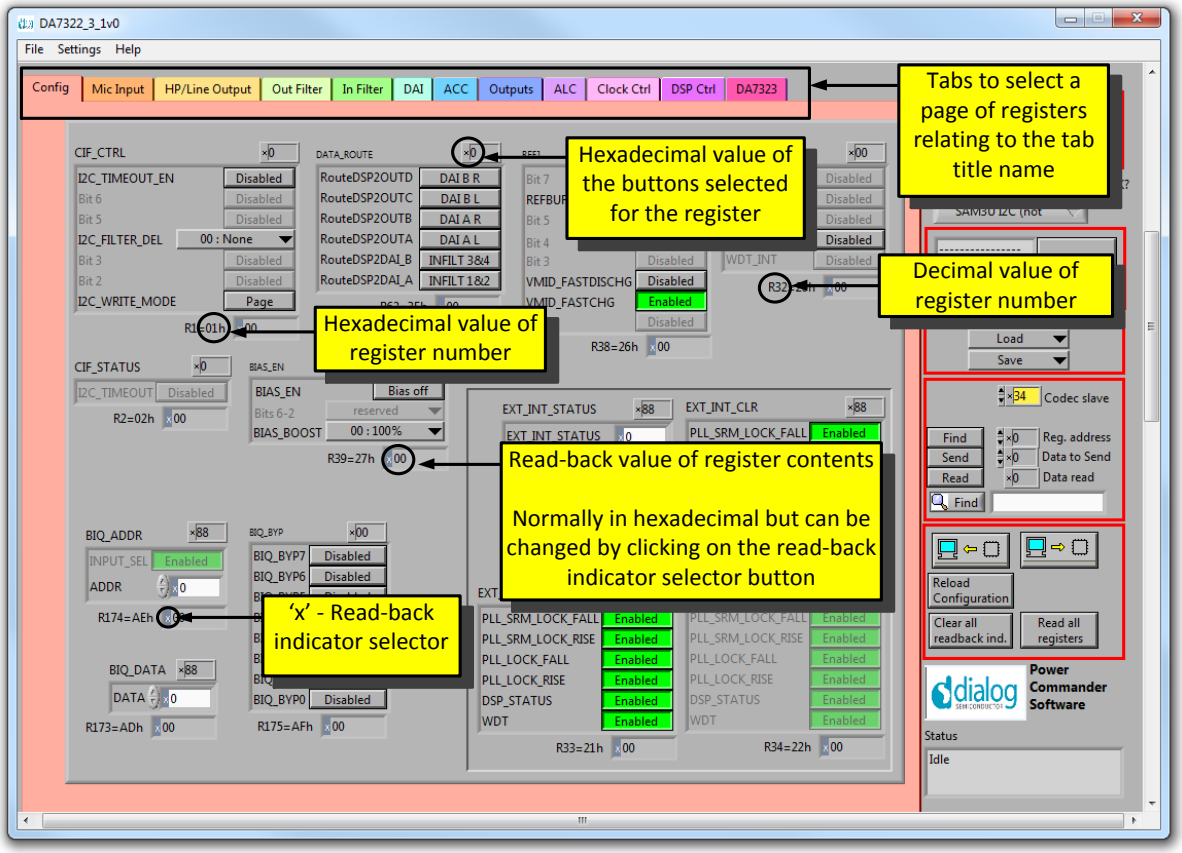

Figure 5: Tabs and read-back indicator

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7 Troubleshooting

This section is an aid to resolving problems occurring in the previous sections.

7.1 Software issues

The USB device should install without difficulty automatically. Make sure that the installation finds and uses the driver contained in the USB memory stick.

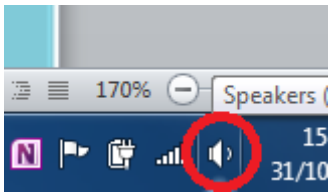
If the program is started before the USB Interface board is plugged in, the program interface button will default to 'SAM3U I2C (not present)'mode. If a board is subsequently attached and not detected, try to move the interface control button to 'offline' mode then to 'SAM3U I2C' for the board to be detected. If this is not successful make sure the USB is connected, then close and restart the program.

If communications are lost during use of the device, switching the 'Interface mode' to Offline, then back to SAM3U I2C will reinitialise the USB interface. If this does not work, unplug the USB cable and then reconnect. The software will detect this and reinitialise.

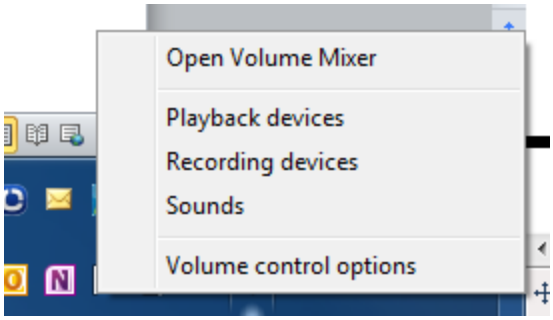
The software has been optimised for a display screen size of 1024 by 768 pixels or greater, with Fonts set to Normal (96dpi). Unpredictable display effects can occur when large fonts (120dpi) are used. To resolve this issue and set the font size to normal in the operating system by right-clicking on the desktop, select Properties. Select the Settings tab, then Advanced, and finally Normal size from the drop-down box (This sequence is dependent on which operating system is being used).

7.1.1 Selecting USB playback

The Dialog DA7322 EVB platform allows a number of audio sources to be selected with ease for testing and evaluation. One example is to stream audio from a PC to the EVB over the USB interface, this can easily be done in the following way.



Right click on speaker symbol in task bar, circled in red



Select playback devices

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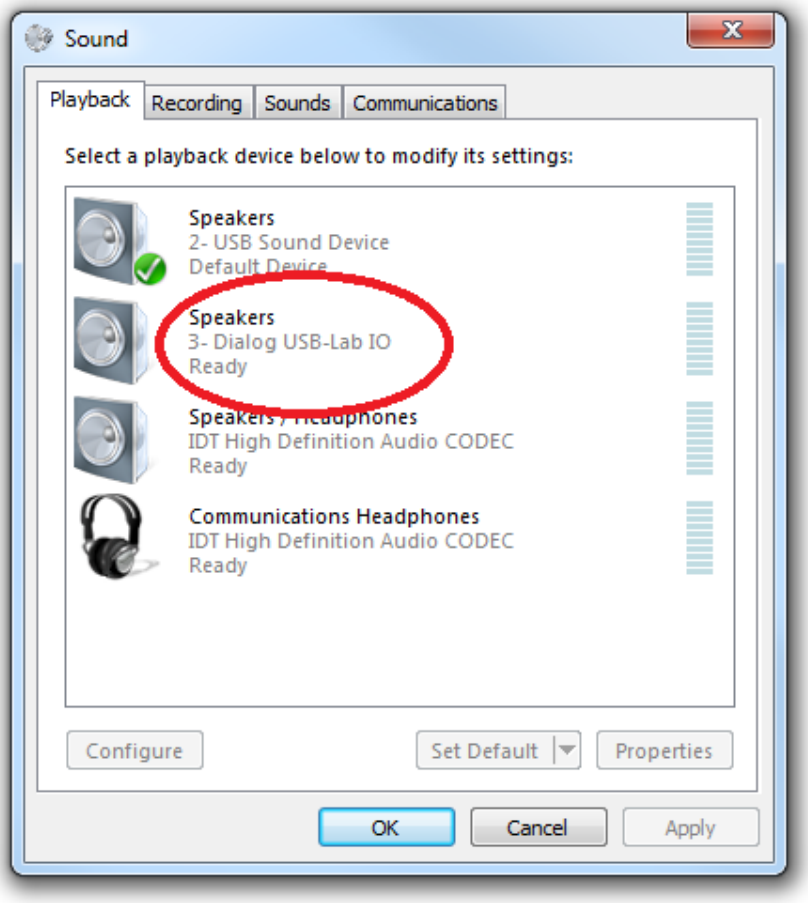

Left click on Dialog US-Lab IO, select 'Set Default' then OK.

Audio played on the PC will now be streamed over USB to the digital IO board for use on the DA7322 board.

7.2 Hardware Issues

The most common hardware issue is caused by not selecting the correct jumper configuration for the desired use case.

Carefully check jumper positions by comparing them with the default positions in Figure 2 and Table 1. Use the jumper table details and the board schematic as a guide to the jumper functions and locations.

7.2.1 MCLK select

When moving to/from SPDIF/USB audio, ensure the correct MCLK source is selected with J16 on the digital IO board. If the incorrect MCLK source is selected, the correct operation cannot be guaranteed and the audio quality may be affected.

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7.2.2 I2C configuration

When using I2C mode, ensure jumpers J23 and J24 are fitted on the EVB. On the digital IO board ensure jumpers J14, 17-18 and 19-20 fitted and jumpers J14, 7-8, 9-10 and 11-12 are removed when in I2C mode is required. See

Table 2 for I2C jumper configuration selection.

The codec slave address for DA7322 is 0x34 and this is the 8bit value (34h for Write, 35h for Read).

7.2.3 SPI configuration

When using SPI mode, ensure jumpers J23 and J24 are removed on the EVB. On the digital IO board, ensure jumper links on J14, 17-18 and 19-20 are removed and jumpers J14, 7-8, 9-10 and 11-12 are fitted when SPI mode is required. See

Table 2 for SPI jumper configuration selection.

When reading/writing to registers in SPI mode, ensure the correct page mode is selected for the paging area selected (register base address 0x00, 0x80 – see DA7322 data sheet).

Table 2: I2C/SPI jumper configuration information

I2C mode selection, Jumper selection		SPI mode selection, Jumper selection	
Digital IO board	**Evaluation board**	**Digital IO board**	**Evaluation board**
J14 - Jumper link 17-18	Fit J23	J14 - Remove link 17-18	Remove J23
J14 - Jumper link 19-20	Fit J24	J14 - Remove link 19-20	Remove J24
J14 - Remove link 7-8		J14 - Jumper link 7-8	
J14 - Remove link 9-10		J14 - Jumper link 9-10	
J14 - Remove link 11-12		J14 - Jumper link 11-12	

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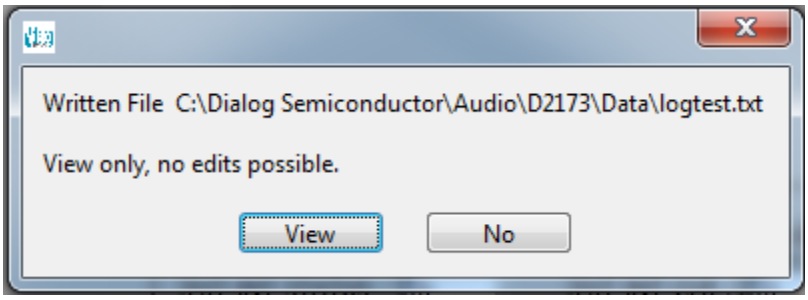
Appendix A Codec text files

A.1 Information

The software includes the ability to save and load a codec text file containing command codes representing the register addresses and data. This file is principally used to save and load setup data, but may also be used to perform a small degree of automation. The text files are saved and loaded via the buttons, 'Load>load Codec file..' and 'Save> Save Codec file..'. The file format type is '.TXT', this can be edited and loaded in any standard text editor software.

The use of the Save\logtest.txt facility permits register contents to be transferred to the user's own software. Clicking on Save\logtest.txt allows the user to save a Register dump of the entire device register map and data contents to file for reference or for use in other software.



Example message box

A.2 Codec file commands

The following formats are used for both read and write in the text file.

- Numbers apart from time delays are always expressed in Hex, separated by tabs. The use of '0x' in front of the hex value is optional.
- The first parameter is the device register address in 8bit format. **OR**
  - The first parameter is a token:
    - 'DELAY' or 'WAIT' will implement a time delay specified up to 65535 ms. The delay time is specified in decimal or hex if preceded by '0x'
- The second parameter is the data.
- Comments (that is lines beginning with '//') are permitted in the file.
- Inline comments (that is //comment) are permitted.
- The data will be processed in the order written and written directly to the specified device. The screen controls will be updated once the commands in the file been processed.

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Example file contents

```
//Write to CODEC
0x09 0xB1            // Writes B1h to register 09h on codec slave address
1F 00                // Writes 00h to register 1Fh on codec slave address


//Wait 255ms
DELAY 255
WAIT 0xFF
```

Revision history

Revision	Date	Description
0.1	02-Apr-2014	Initial version.
0.2	15-Apr-2014	Updated draft version
0.3	19-May-2014	Updated draft version
0.4	28-Jun-2014	Updated draft version
0.5	29-Jul-2014	Updated draft version
0.6	15-Sept-2014	Updated draft version

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Status definitions

Status	Definition
DRAFT	The content of this document is under review and subject to formal approval, which may result in modifications or additions.
APPROVED or unmarked	The content of this document has been approved for publication.

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